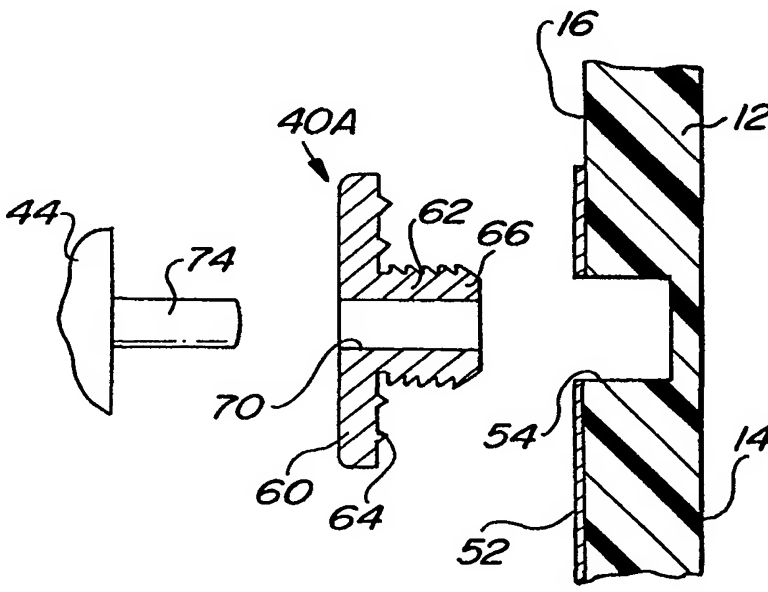


INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/US99/17684 (22) International Filing Date: 4 August 1999 (04.08.99) (30) Priority Data: 09/129,561 5 August 1998 (05.08.98) US (71) Applicant: LEAR AUTOMOTIVE DEARBORN, INC. [US/US]; 21557 Telegraph Road, Southfield, MI 48034 (US). (72) Inventors: WOJEWNIK, Albert; 3350 Ellwood, Royal Oak, MI 48073 (US). REICH, Ronald, K.; 865 Valley Circle Drive #102, Saline, MI 48176 (US). (74) Agent: MOLNAR, John, B.; MacMillan, Sobanski & Todd, LLC, 4th floor, One Maritime Plaza, 720 Water Street, Toledo, OH 43604 (US).		(81) Designated States: JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(54) Title: TRIM PANEL HAVING ELECTRICAL CONNECTORS		
(57) Abstract		
<p>A vehicle trim panel assembly includes a trim panel of electrically non-conductive material that has an interior and an exterior surface. The exterior surface includes decorative trim mounted on it such as vinyl, leather, or cloth, for example, which makes that exposed surface visually appealing. An electrical circuit is deposited upon and adhered to the interior surface using a thermal spray process. The trim panel further includes recessed cavities proximate to the electrical circuit. Electrical connectors are fixedly secured in the recessed cavities so as to achieve an electrical connection with the electrical circuit. In this way, any number of first or second electrical connectors may be created. Electrical components then may be attached to the first and second connectors. A vehicle wire harness is attached to the first connector while components such as a window regulator and rear view mirror control are attached to any number of second connectors.</p> <div data-bbox="568 1134 1331 1722" data-label="Image">  <p>The diagram illustrates a trim panel assembly in cross-section. It shows a main panel (12) with a decorative trim layer (14) on its exterior surface. A recessed cavity (16) is formed in the panel. Within this cavity, there is an electrical circuit (52) and a first electrical connector (54). A second electrical connector (60) is also shown, secured in the cavity. The diagram includes various labeled components: 44 (trim layer), 74 (electrical circuit), 40A (connector), 62 (cavity), 66 (cavity), 70 (cavity), 60 (connector), 64 (cavity), 16 (cavity), 12 (panel), 14 (trim layer), 54 (connector), and 52 (circuit).</p> </div>		

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TRIM PANEL HAVING ELECTRICAL CONNECTORS

BACKGROUND OF THE INVENTION

The subject invention relates to a vehicle trim panel assembly having an integrally molded electrical circuit and separately connectable electrical connectors.

5 Vehicles have trim panels mounted to interior surfaces of the body to present a pleasing appearance. As an example, door trim panels are mounted to the interior surface of a door assembly. Typically, vehicle door assemblies include spaced apart inner and outer panels defining a cavity for mounting a window, window regulator, speakers and other mechanical and electrical devices. These devices are installed
10 inside the door cavity through a plurality of access openings provided in the door inner panel.

A door trim panel conceals this interior surface of the door, and is conventionally formed of a rigid panel, such as molded plastic or pressed hardboard. The exterior of the trim panel, which faces the vehicle occupant, is covered with a
15 flexible decorative trim material such as cloth, vinyl, leather and/or carpeting, thereby creating a pleasing appearance to the occupant. The door trim panel is secured to the door by suitable fasteners.

The door trim panel also often supports a number of electrical components. The components include lights, window controls, rear view mirror controls, door
20 lock controls, seat adjustment controls, and speakers. Each of these electrical components requires an individual wiring connector power supply lead wires and perhaps control wires. The wires are typically bundled together to create what is commonly called a wire harness. The wire harness is fixed to the trim panel or to

the door to hold the wire harness. The wire harness is connected to a main wire harness that enters the door cavity near the hinged end of the door. As can be appreciated, the mounting and wiring of these electrical components is labor intensive and requires a number of connectors and other electrical parts.

5 Solutions to this problem have been contemplated by the prior art. Specifically, it has been proposed that the wires be mounted, molded, etched, printed, or otherwise affixed to a separate rigid board material. The rigid board is in turn mounted to either the trim panel or the door or both. Hence, in these proposals, the door assembly includes the door itself, a rigid board, and the trim
10 panel. These proposals, however, have a number of deficiencies. One deficiency is the same as with the loose bundle of wires, that is, a significant amount of intensive manual labor is required to mount the wires to the board, mount the connectors to the board, and then mount the board itself to either the trim panel or the door. Further, additional connectors must be mounted on the board to
15 electrically connect the connectors from the door to the connectors on the trim panel.

 Copen pending application serial number 09/053,395 entitled "Trim Panel with Integrally Formed Electrical Circuits" and filed April 1, 1998, and serial number 09/085,986 entitled "Trim Panel Having Grooves with Integrally Formed Electrical
20 Circuits" and filed May 27, 1998, disclose methods of forming the circuits on the trim panel. There has now been developed improved methods for forming connectors in these earlier applications.

SUMMARY OF THE INVENTION

The present invention provides a vehicle trim panel assembly that includes a trim panel of electrically non-conductive material that has an interior and an exterior surface. The exterior surface includes decorative trim mounted on it such as vinyl, leather, or cloth, for example, which makes that exposed surface visually appealing. An electrical circuit is deposited upon and adhered to the interior surface using a thermal spray process. The trim panel further includes recessed cavities proximate to the electrical circuit. Electrical connectors are fixedly secured in the recessed cavities so as to achieve an electrical connection with the electrical circuit.

In this way, any number of first or second electrical connectors may be created. Electrical components then may be attached to the first and second connectors. A vehicle wire harness is attached to the first connector while components such as a window regulator and rear view mirror control are attached to any number of second connectors.

The invention thus provides a vehicle trim panel having an integrally molded electrical circuit for interconnecting any number of electrical devices and a electrical connector for transferring electrical current from the circuit to an electrical component. The trim panel of the subject invention can be efficiently manufactured and simply requires the user to press fit the electrical connector into the panel itself.

In other words, all of the parts necessary to electrically connect an electrically operated component to an electrical supply are included within the trim panel itself. These parts include the connectors and the electrical circuit that is integrally molded into the trim panel.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

5 Figure 1 is a perspective view of a trim panel assembly in spaced relationship to a vehicle door assembly;

Figure 2 is an exploded perspective view from area 2 of Figure 1;

Figure 3A is a partial cross-sectional view of an electrical connector;

Figure 3B is a view of one feature of the Figure 3A connector;

10 Figure 4 is a partial cross-sectional view of a second embodiment of an electrical connector;

Figure 5 is a partial cross-sectional view of the electrical connector in spaced relationship from the trim panel;

15 Figure 6 is a cross-sectional view of a third embodiment of an electrical connector;

Figure 7 is a partial cross-sectional view of a fourth embodiment of an electrical connector wherein the connector is ultrasonically welded to a trace; and

20 Figure 8 is a partial cross-sectional view of a fifth embodiment of an electrical connector in spaced relationship from the trim panel in which the connector is being spin welded to a trace.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Vehicle trim panel assembly 10 as shown in Figure 1 includes trim panel 12 constructed of electrically non-conductive material having an exterior surface 14 and

an interior surface 16. Trim panel 12 is shown as an automotive door trim panel which mounts to a vehicle door assembly, generally shown at 18. However, the trim panel of the subject invention may be any type of trim panel associated with a vehicle without deviating from the scope of the subject invention. Other types of trim panels include trunk panels, quarter panels, rear package trays, headliners, instrument panels, garnish moldings, console panels, etc.

The vehicle door assembly 18 includes spaced apart inner 20 and outer 22 metal panels defining a cavity 24 for receiving a window, window regulator, speakers, and other electrical devices (not shown). A plurality of access openings 26 are provided in the inner panel 20 to allow access into the cavity 24 of the door assembly 18. The door trim panel 12 is utilized to conceal this interior surface 20 of the vehicle door 18.

Door trim panel 12 is preferably formed of a molded plastic such as polypropylene. As appreciated by those skilled in the art, the trim panel 12 may alternatively be fabricated of wood fibers, polyurethane, solid molded vinyl, expanded polyurethane foam, any combination thereof or any other suitable rigid electrically non-conductive material. The exterior surface 14 of the trim panel 12 may include a decorative surface. Specifically, the trim panel 12 may be covered with a flexible decorative trim material such as cloth, vinyl, leather, and/or carpeting. The trim panel 12 is attached to the vehicle door 18 by suitable fasteners as are well known in the art.

The interior surface 16 of the trim panel 12 includes a first electrical connector 30 and a second electrical connector 40, as best shown in Figure 2.

Returning to Figure 1, the first electrical connector 30 is adapted to receive the wire harness 32 extending into the cavity 24 near the hinged end of the door. As shown in the preferred embodiment there are a number of second electrical connectors 40. The interior surface of the trim panel also supports a number of electrical components. These components can include window controls 42, rear view mirror controls 44, door lock controls 46, speakers 48, etc. Each of these electrical components 42,44,46,48 has an associated set of second electrical connectors 40.

An electrical circuit, generally shown at 50, is integrally deposited on and adhered to the interior surface 16 of the trim panel 12 for electrically connecting the first electrical connector 30 to the plurality of second electrical connectors 40. The method of depositing the electrical circuit 50 may be accomplished by flame spraying molten metal particles or any other suitable means as disclosed in copending applications serial number 09/053,395 entitled "Trim Panel with Integrally Formed Electrical Circuits" and filed April 1, 1998, and serial number 09/085,986 entitled "Trim Panel Having Grooves with Integrally Formed Electrical Circuits" and filed May 27, 1998, which are herein incorporated by reference. The electrical circuit 50 formed within the trim panel 12 comprises a plurality of spaced apart circuit traces 52 or strips of conductive material.

As appreciated by those skilled in the art, most electrical components require at least two input supply wires, i.e., a ground wire and an input wire carrying an electrical current. Further, if the electrical component is a switch, there will be at least one output wire also carrying an electrical current. Hence, the number of traces 52 formed in the electrical circuit 50 will depend on the number and type of

electrical components used. Each individual trace 52 can vary in width and thickness to accommodate varied gauges and to customize resistivity.

As discussed above, the trim panel 12 is mounted to the inner panel 20 of the vehicle door assembly 18. To prevent a short circuit the electrical circuit 50 of the trim panel 12 is preferably spaced some distance from the door assembly 18. Further, an insulative coating (not shown) or similar material may be applied over the electrical circuit 50 to create a protective moisture barrier between the door assembly 18 and the trim panel 12.

Referring to Figures 3A through 8, the electrical connectors 40 of the subject invention are shown in greater detail. At least one recessed cavity 54, best seen in Figure 5, is disposed within the interior surface 16 of the trim panel 12. The trace 52 is proximate to the recessed cavity 54. An electrical connector 40 is received and fixedly secured within the recessed cavity 54 and is in contact with the trace 52 thereby providing electrical conductivity between the trace 52 and the electrical connector 40.

As shown in Figure 3B, preferably, the trace 52 extends at least partially, and most preferably entirely around the recessed cavity 54 to better achieve an electrical connection.

Various configurations of the electrical connector may be used and different methods of installation may be incorporated to attain a secure attachment to the trim panel and an adequate electrical connection with the trace. The embodiment of the electrical connector 40A, 40B, shown in Figures 3A and 4, includes a flange 60 and a shank 62. The flange 60 engages the circuit traces 52. Additionally, teeth

64 may project from the flange 60 for piercing the circuit traces 52 and further enhancing the electrical connection. Preferably, the flange 60 and the teeth 64 are welded to the circuit trace. Also it may be preferable that the electrical connector 40 is entirely formed of an electrically conductive material so that any portion of the electrical connector 40 that contacts the trace 52 is able to conduct electricity. The shank 62 extends within the cavity 54 to fixedly secure the electrical connector 40 to the trim panel 12. The shank 62 may further incorporate barbs 66 that project outwardly from the shank 62 to assist in retaining the shank 62 within the cavity 54.

Either a male or female connector may be used. Referring specifically to Figures 3A and 5, a bore 70 extends through the shank 62 thereby forming a female connector 40A. The female connector is adapted to coact with a portion of an electrical component that is complementary in configuration to the bore 70. That is, the female connector is intended to engage a male connector 74 from an electrical component 44 so that the electrical component 44 is in electrical communication with the electrical connector 40.

Referring specifically to Figure 4, a projecting finger 72 extends outwardly from the flange 60 opposite the shank 62 thereby forming a male connector. The male connector 40B is adapted to coact with a portion of an electrical component that is complementary in configuration to the finger 72. That is the male connector is intended to engage a female connector 76 from an electrical component 44, so that the electrical component 44 is in electrical communication with the electrical connector 40.

In yet another embodiment, an electrical connector 40C is riveted to the trim

panel 12 at the recessed cavity 54, as shown in Figure 6. As with the previous embodiments, the flange 60 engages the trace 52, hence making electrical contact with the trace 52. An annular lip 80 opposite the flange 60 and adjacent to the exterior surface 14 is deformed thereby compressing the trim panel 12 and securely
5 attaching the connector 40 thereto.

Figures 7 and 8 depict embodiments in which the electrical connector 40 is welded, in some fashion, to the trace 52. An electrical connector 40 having a shank 62 that includes a tapered annular ring 90 is shown seated in cavity 54 in Figure 7. The electrical connector 40 is ultrasonically welded to the trace 52. Alternatively,
10 as shown in Figure 8, the electrical connector 40 can be inserted into the cavity 54 and spin welded thereby achieving an electrical connection between the flange 60 and the trace 52. Additionally, as a result of the heat generated within the cavity 54 during spin welding, the shank 62 is securely retained therein.

The invention has been described in an illustrative manner, and it is to be
15 understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation. Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

20

CLAIMS

WHAT IS CLAIMED IS:

1. A vehicle trim panel assembly comprising:
 - a trim panel of electrically non-conductive material having an interior
 - 5 surface;
 - said interior surface including a first electrical connector and a second electrical connector;
 - an electrical circuit integrally deposited upon and adhered to said interior surface of said trim panel;
 - 10 at least one recessed cavity disposed within said interior surface of said trim panel and proximate to said electrical circuit; and
 - at least one of said first and second electrical connectors received and fixedly secured within said recessed cavity and in contact with said electrical circuit thereby providing electrical conductivity between said electrical circuit and said electrical
 - 15 connector.
2. The assembly as set forth in claim 1 wherein said electrical circuit comprises a plurality of spaced apart circuit traces integrally formed within said trim panel.
3. The assembly as set forth in claim 1 wherein said electrical circuit at
- 20 least partially surrounds said recessed cavity.
4. The assembly as set forth in claim 2 wherein said electrical connector includes a flange portion and a shank portion wherein said flange portion engages said circuit traces and said shank portion extends within said cavity to fixedly secure

said electrical connector to said trim panel.

5. The assembly as set forth in claim 4 further including teeth projecting from said flange for engaging said circuit traces.

6. The assembly as set forth in claim 5 wherein said flange and said teeth are welded to said circuit trace.

7. The assembly as set forth in claim 5 further including barbs projecting outwardly from said shank to assist in retaining said shank within said cavity.

8. The assembly as set forth in claim 4 wherein said electrical connector is a rivet.

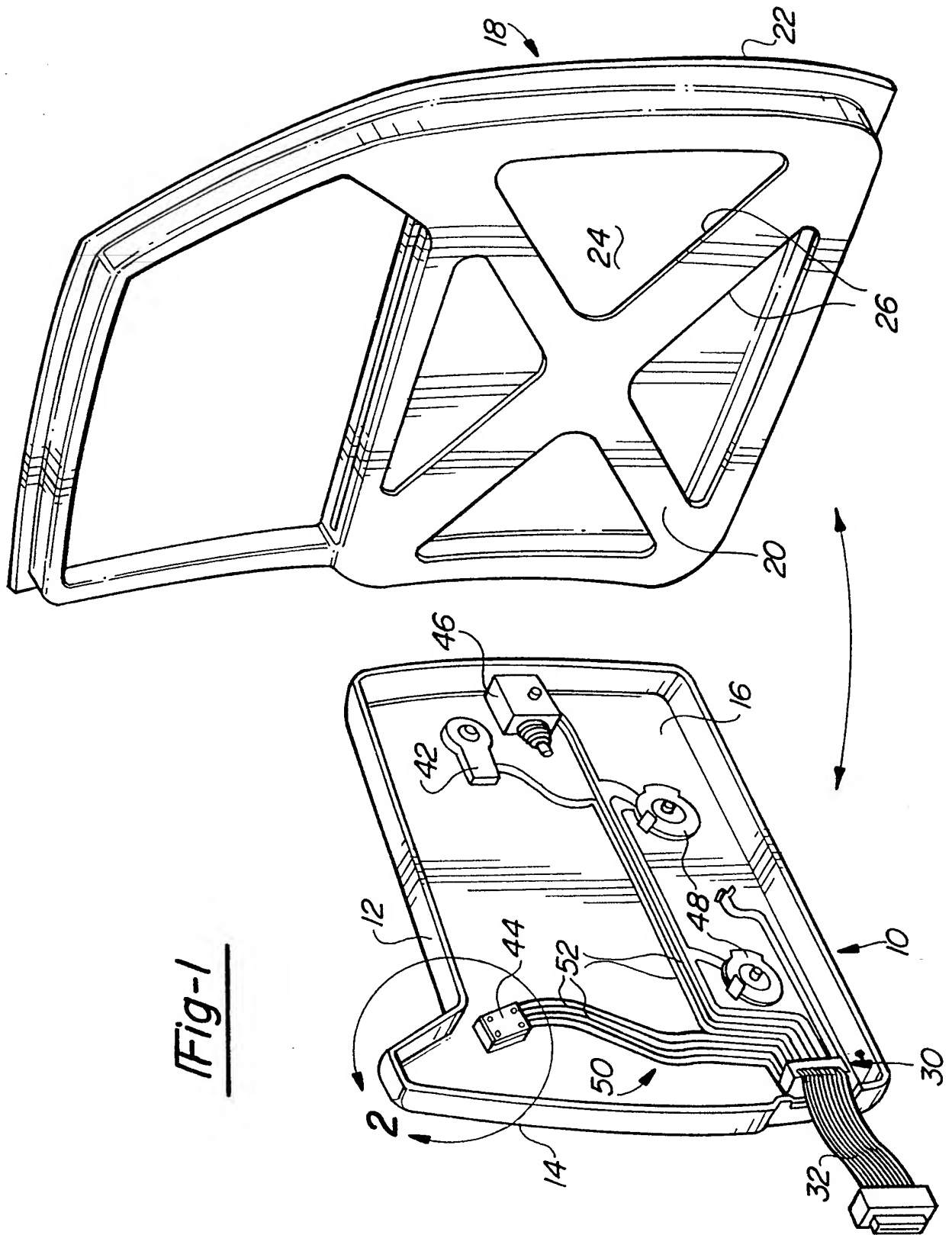
9. The assembly as set forth in claim 4 wherein said electrical connector is ultrasonically welded to said circuit trace.

10. The assembly as set forth in claim 4 wherein said electrical connector is spin welded to said circuit trace.

11. The assembly as set forth in claim 4 wherein said electrical connector is entirely formed of an electrically conductive material.

12. The assembly as set forth in claim 4 further including a bore extending through said shank wherein a portion of an electrical component is complementary in configuration to said bore such that said electrical component may electrically communicate with said electrical connector when said portion engages said electrical connector.

13. The assembly as set forth in claim 4 further including a finger extending from said flange wherein a portion of an electrical component is complementary in configuration to said finger such that said electrical component may electrically communicate with said electrical connector when said portion engages said electrical
5 connector.



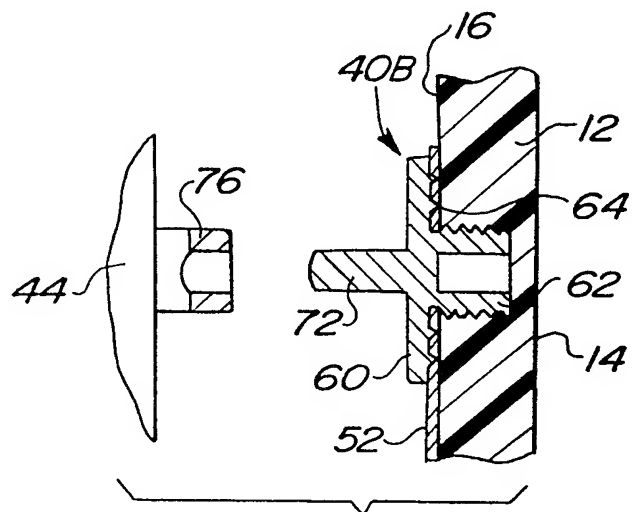
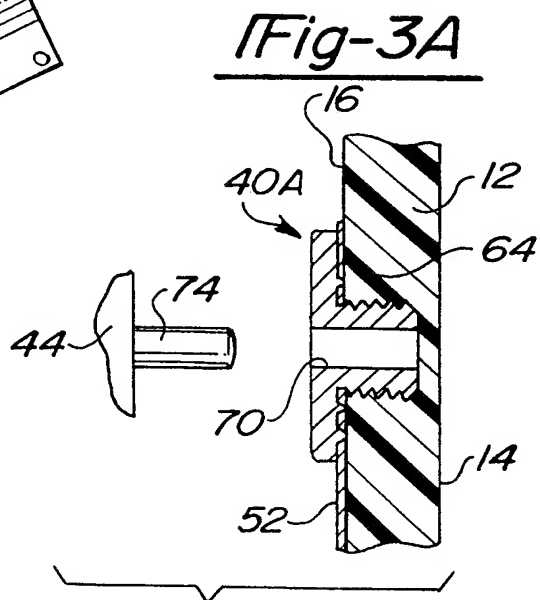
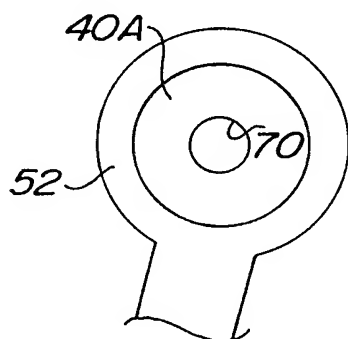
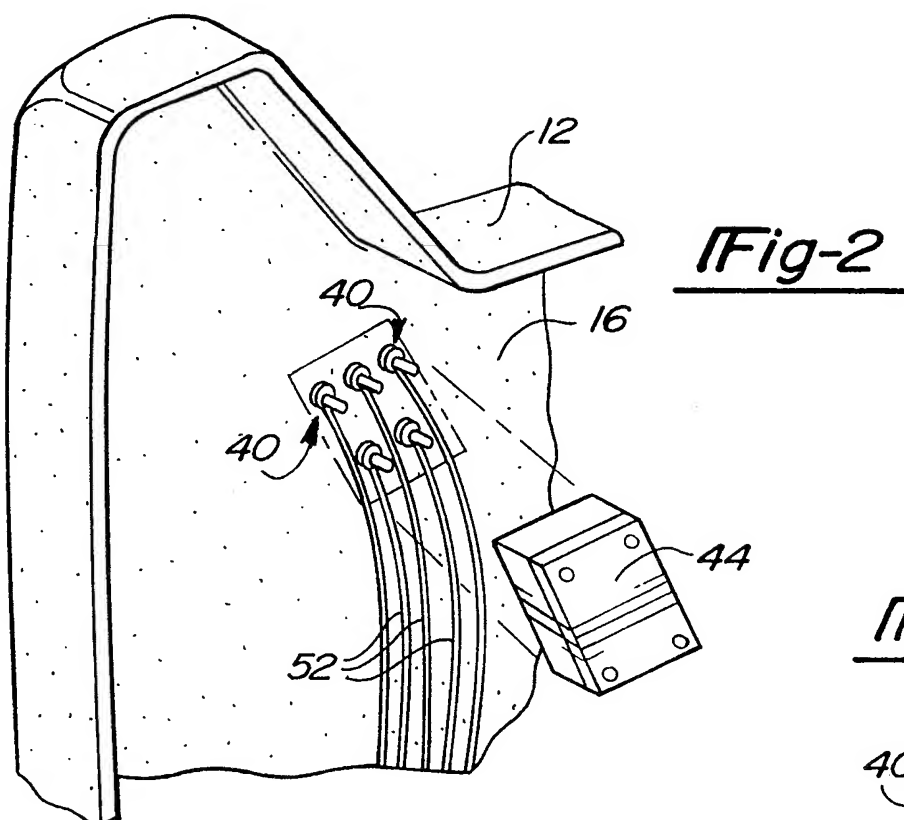


Fig-5

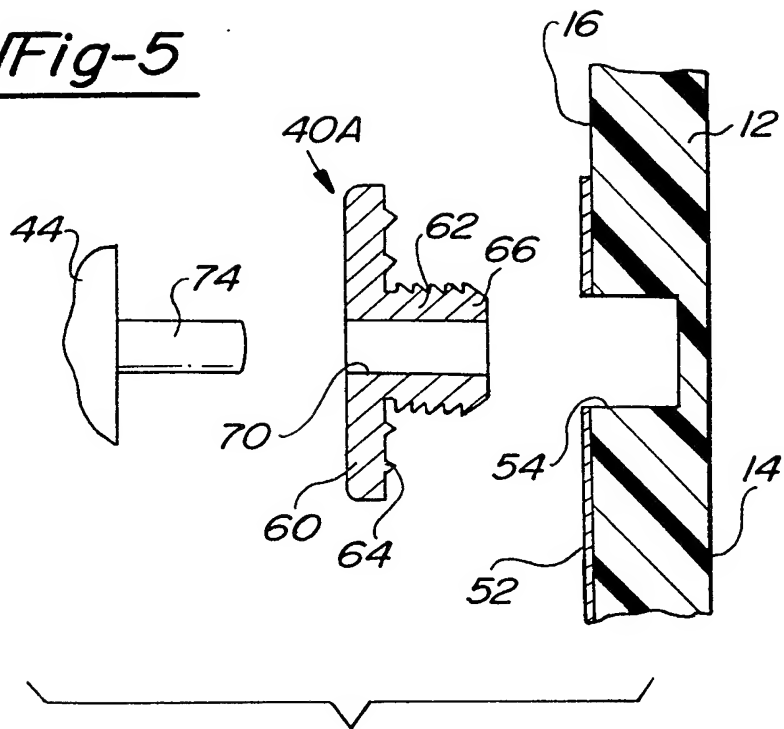


Fig-6

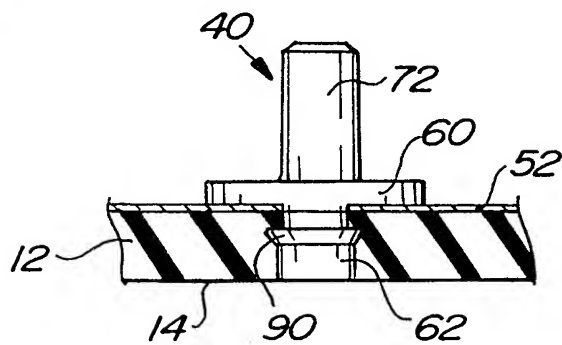
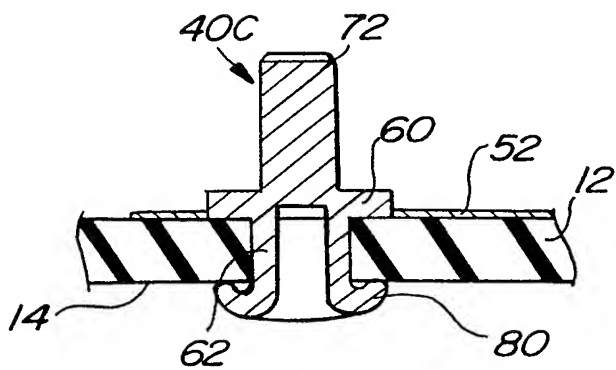


Fig-7

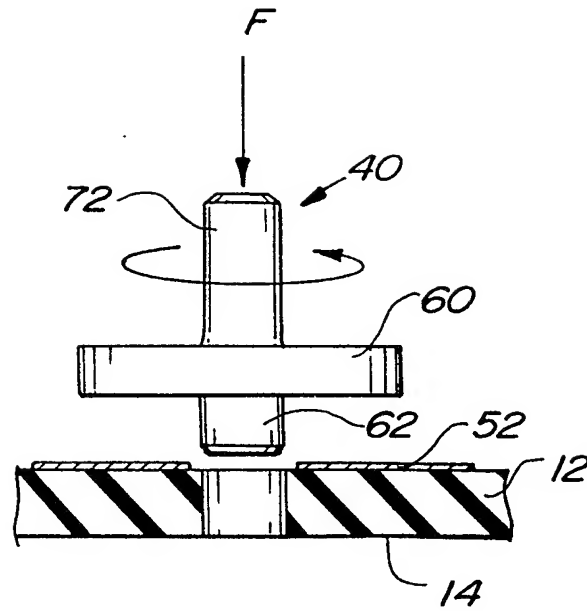


Fig-8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 99/17684

A. CLASSIFICATION OF SUBJECT MATTER				
IPC7: B60R 16/02 According to International Patent Classification (IPC) or to both national classification and IPC				
B. FIELDS SEARCHED				
Minimum documentation searched (classification system followed by classification symbols)				
IPC7: B60R, H01R				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	WO 9721563 A1 (UNITED TECHNOLOGIES AUTOMOTIVE, INC.), 19 June 1997 (19.06.97), page 3, line 11 - line 20; page 3, line 24; page 4, line 1 - line 4, ;page 11, line 4; page 12, line 16 - page 13, line 6; page 16, line 16 - line 19; page 17, line 6 - line 20; page 18, line 19 - page 19, line 1; figure 1,3,4,6,10-12; abstract --	1-12		
A	WO 9803373 A1 (UNITED TECHNOLOGIES AUTOMOTIVE, INC.), 29 January 1998 (29.01.98), abstract --	1-12		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; border: none;"> * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td style="width: 50%; vertical-align: top; border: none;"> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family </td> </tr> </table>			* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 99/17684

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5712764 A (JAY DEAVIS BAKER ET AL.), 27 January 1998 (27.01.98), abstract -- -----	1-12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US 99/17684

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9721563 A1	19/06/97	US 5805402 A US 5936818 A	08/09/98 10/08/99
WO 9803373 A1	29/01/98	EP 0912371 A EP 0912372 A US 5735041 A US 5743010 A WO 9803374 A	06/05/99 06/05/99 07/04/98 28/04/98 29/01/98
US 5712764 A	27/01/98	EP 0897350 A WO 9742059 A	24/02/99 13/11/97